THE AMERICAN MINERALOGIST
JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

Vol. 11. FEBRUARY, 1926 No. 2

SAND-CALCITE CRYSTALS FROM MONTEREY COUNTY, CALIFORNIA*

A. F. ROGERS, *Stanford University*
AND
R. D. REED, *Palo Alto, California*

I. OCCURRENCE BY R. D. REED

Sand crystals of such minerals as calcite, gypsum, and barite have been found in widely scattered localities, many of them in the more arid parts of the world. They have given rise to several interesting mineralogical and geological investigations, to some of which references[1] are given below. The purpose of the present paper is to describe a new California occurrence of sand-calcite crystals of peculiar crystallographic development.

These crystals occur in the Cholame Hills, the highest part of a well-known mesa which lies between the San Andreas Fault and the Salinas River in southeastern Monterey County. The marginal portions of the mesa are of fairly complex structure, one of the most complicated portions being the Cholame Hills. A brief account of the geology, with a reconnaissance map, has been published by the United States Geological Survey.[2]

The crystals occur in a limited portion of an outcrop of clean, white, poorly cemented sand of Santa Margarita (upper Miocene) age, near a fault contact with Pliocene strata, perhaps of much later age. They show no close relation either to bedding planes or joint cracks in the sand. No outcrops of limestone, either in the older or younger formation, have been seen in this vicinity, but there are, scattered over the surface above the Pliocene strata—which are not well exposed—many fragments of hard massive limestone of a peculiar kind. These fragments are very similar to those furnished by thin beds of limestone widely distributed in the Paso Robles formation (non-marine Pliocene) in other parts of the same general area. Their abundance in this part of the Cholame Hills suggests that the strata in contact with the Santa Margarita formation may be Paso Robles, and not marine Pliocene as the map of the Geological Survey indicates. The fact that the contact seems clearly to be a fault tends to confirm this idea. Only a detailed examination of the general area can settle the matter.

---

* Paper presented at the annual meeting of The Mineralogical Society of America, Ithaca, N. Y. Dec. 31, 1924.

[1] B. Doss, Ueber sandhaltige Gypskrystalle vom Bogdo-Berge in der Astrachanschen Steppe, *Z. deut. geol. Ges.*, **49,** 143-151, 1897. (References to other occurrences, *op. cit.*, 150, 151.) E. H. Barbour, Sand crystals and their relation to certain concretionary forms, *Bull. Geol. Soc. Am.*, **12,** 165-172, 1901. H. W. Nichols, New forms of concretions, *Field Columbian Museum Pub.*, geol. ser. **3,** 25-54, 1906. J. E. Pogue, On sand-barites from Kharga, Egypt, *Proc. U. S. National Museum*, **38,** 17-19, 1910. J. Walther, Das Gesetz der Wüstenbildung, vierte Auflage, 72-75, Abb. 58-60, *Leipzig*, **1924**. H. R. Wanless, Notes on sand-calcite from South Dakota, *Am. Mineral.*, **7,** 83-86, 1922.

[2] W. A. English, Geology and oil prospects of the Salinas Valley-Parkfield area, California, *U. S. Geol. Survey Bull.*, **691-H,** 1918.

Rough chemical determinations show that the proportion of sand to calcite in the crystals is about 65 to 35. This agrees well with an average of 63 per cent sand in the Great Plains crystals studied by Barbour.[3] The sand of the crystals is similar to that of the matrix in which they occur. It is coarse and composed chiefly of angular quartz grains. Feldspar is much less common than in most other Tertiary sandstones of California. Heavy minerals are also present in small amount, the commonest species being titanite.

The only isolated sand-calcite crystals and groups of crystals and concretions that have been found are in an area a hundred yards long and a few yards wide, in section 14, T. 23 S., R. 13 E. A few miles west of this locality, however, in the Narrows, section 21, T. 23 S., R. 13 E., the Santa Margarita sandstone crops out again, here overlain by several hundred feet of diatomaceous shale, as well as by the marine and non-marine strata of the Pliocene. Instead of white, uncemented sand, however, the Santa Margarita formation is here a resistant calcareous sandstone with a peculiar nodular appearance on weathered surfaces. The calcite of the nodules, as shown by the cleavage planes on a fractured surface, is in large anhedral crystals, but no euhedral crystals or concretions were seen.

The origin of sand-calcite crystals is not always entirely clear. Walther groups them with the products of insolation and evaporation in desert areas. "Auch die bekannten Sand-Kalkspate von

---

[3] E. H. Barbour, *op. cit.*, p. 170.

Fontainebleau gehören hierher."[4] The conditions at Fontainebleau are described in more detail in a suggestive passage by Jukes.[5] The sand, he says,

> "is covered in places by beds of freshwater limestone called the Calcaire de Beauce. Water containing carbonate of lime in solution percolates through the sand and deposits the lime, binding the sand either into globular concretions, or even into rhombohedral crystals, such as carbonate of lime ordinarily forms. Besides these smaller concretions, other large parts of the sand have been compacted together into a very hard gritstone, which is extensively used as a paving stone."

In the Wyoming locality Barbour notes the same transition "from the solitary crystals to the concretions, compound concretions or pipes, to the compound pipes and solid rock," but says little about the source of the calcium carbonate and the conditions of its precipitation. In the Cholame Hills the complex structure makes it impossible to discuss these problems profitably without more work than has yet been devoted to them. In any case the geologic significance of these concretions, as stages toward the development of a completely cemented stratum, is sufficiently clear.

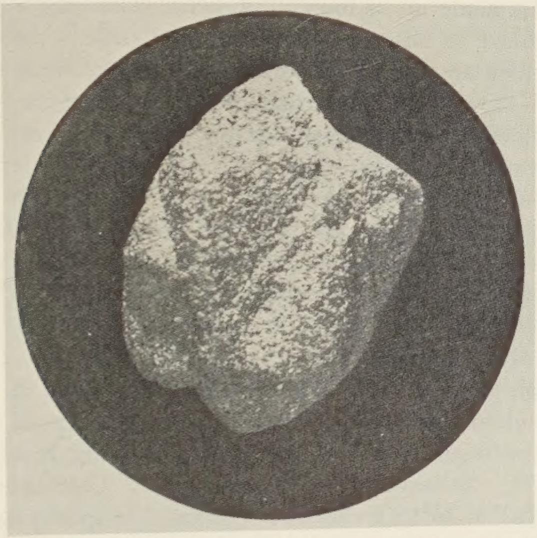

Fig. 1. Sand-Calcite Twin-Crystal from Cholame Hills, Monterey Co., California.

---

[4] J. Walther, *op. cit.*, p. 75.

[5] J. Beete Jukes, The Student's Manual of Geology, third edition. Sir. A. Geikie, *Edinburgh*, **1872**, Chapter XV.

II. Crystallography by Austin F. Rogers

The specimens collected by Dr. Reed, and presented by him to Stanford University, vary from rough concretions which approach a spherical form to well-formed crystals such as those illustrated in Fig. 1. Most of the specimens show a confused mass of projecting crystals without any apparent relation to one another. An occasional simple crystal was noted. The most interesting of all the specimens are those represented by Fig. 1. For this photograph I am indebted to my colleague, Professor F. G. Tickell. At first glance these seem to be penetration twins of two hemimorphic crystals but a closer study proves them to be penetration cyclic twins made up of four individuals. The only form present is the negative or inverse rhombohedron *f*$\{02\bar{2}1\}$, the edges and faces of which are somewhat rounded, partly by wear and partly by crystal growth. Surrounding the central crystal, the lateral edges of which show in the photograph, are three other individuals each in twinning position. Fig. 2 shows a plan and elevation of a twin-crystal in ideal development. The photograph of Fig. 1 was taken in the same position as the elevation of Fig. 2. The relation of two individuals of the twin is shown in the right-hand drawing of Fig. 2. The twin-plane is the form $\{01\bar{1}2\}$, but the composition plane is a plane at right angles to $\{01\bar{1}2\}$, which plane is not a crystallographically possible face.

The angle $(02\bar{2}1 : \underline{02\bar{2}1})$ was measured by means of a Penfield contact goniometer from a wax impression of a part of the photographed specimen of Fig. 1 with the following results: Limits 72°30′-74°0′. Average of 10 values = 73°8′. Calculated value = 73°44′. 2(63°7′-26°15′) = 73°44′. On another specimen, the edge and arm of the goniometer were held in the line of sight of the two faces mentioned and the following results were obtained: Limits 72°30′-75°0′. Average of 10 values = 73°32′. Calculated value = 73°44′.

In most twin-crystals the two individuals are on opposite sides of the twin-plane but occasionally, as has been pointed out by Spencer,[6] the two individuals may be on the same side of the twin-plane. Such is the case in the sand-calcites here described. In the abstract[7] of this paper it was stated that the twin-plane is the positive or direct rhombohedron, $\{20\bar{2}1\}$. This twin-law for calcite was described by Lacroix[8] on crystals from Saint-Julien-de-Valgalgues, France. In the case of $\{20\bar{2}1\}$ as a twin-plane the angle $02\bar{2}1 : \underline{02\bar{2}1}$ is 72°28′ instead of 73°44′. 180°-2[180°-2(63°7′)] = 72°28′. The difference of 1°16′ is practically within the limits of error for rough crystals such as these sand-calcite crystals. The

---

[6] *Mineralog. Mag.*, **18,** 82, 1916.

[7] *Am. Mineral.*, **10,** 68, 1925.

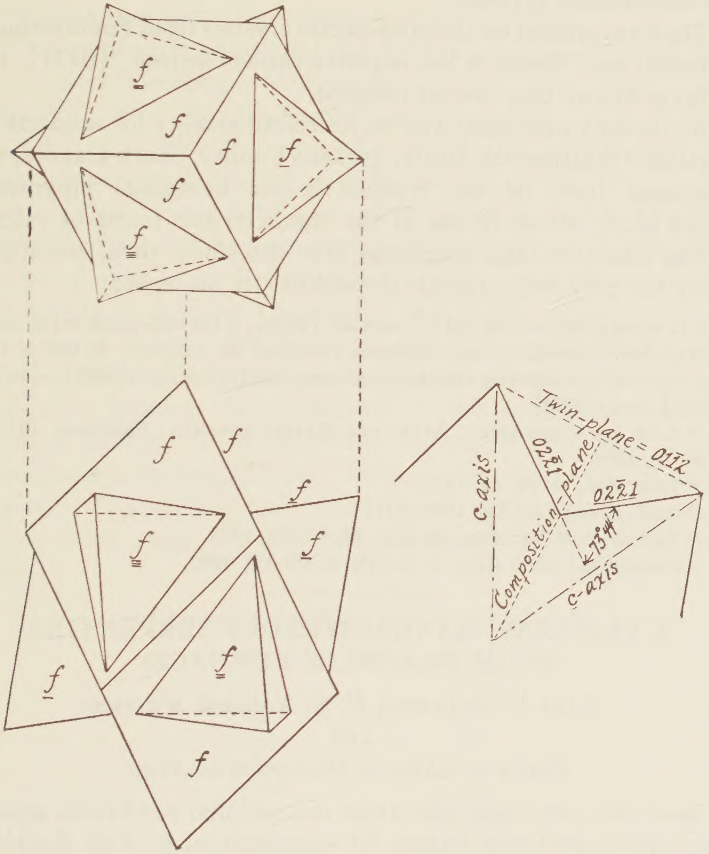
$\underline{f}$
f
f
f
f
$\underline{\underline{\underline{f}}}$
f
f
f
$\underline{f}$
$\underline{\underline{\underline{f}}}$
$\underline{f}$
$\underline{\underline{f}}$
f
Twin-plane = $01\bar{1}2$
$02\bar{2}1$
Composition-plane
c-axis
$\underline{02\bar{2}1}$
73°44′
c-axis

Fig. 2. Plan and Front Elevation of Sand-Calcite Twin-Crystal from Cholame Hills, Monterey Co., California. ($f\{(02\bar{2}1\}$, Twin-plane = $\{0\bar{1}12\}$).

$(10\bar{1}1)$ cleavage truncations of the polar edges of the central crystal and two other individuals of the sand-calcite crystals are in the same plane, since they reflect light at the same time. This observation is proof that $\{01\bar{1}2\}$ and not $\{20\bar{2}1\}$ is the twin-plane, for only in the former case are cleavages of two individuals parallel.[9]

---

[8] Mineralogie de la France, **3**, 563-4, 1909.

Calcite twins of this type have been described from Elba,[10] Eisenerz[11] (Styria), Hüttenberg[12] (Carinthia), Rancie[13] (France), and Velmanya[13] (France). None of these twin-crystals, however, are sand-calcite crystals.

The form present on the sand-calcite crystals from Fontainebleau (France) and Vienna is the negative rhombohedron $f\{02\bar{2}1\}$, but as far as known they are not twinned.

At the only previously known American locality for sand-calcite crystals,[14] Rattlesnake Butte, Jackson County, South Dakota, the dominant form on the crystals is the hexagonal bipyramid, $\gamma\{8.8.\overline{16}.3\}$, which is one of the characteristic forms of calcite.

The Cholame Hills specimens here described, then, are apparently the only twin-crystals of sand-calcite on record.

[9] It seems probable that $\{01\bar{1}2\}$, and not $\{20\bar{2}1\}$, is the twin-plane in the calcite crystals from Saint-Julien-de-Valgalques described by Lacroix. If this is true, then only the four following twin-laws are exemplified in calcite: $c\{0001\}$, $e\{01\bar{1}2\}$, $r\{10\bar{1}1\}$, and $f\{02\bar{2}1\}$.

[10] Rath, see Goldschmidt, ATLAS DER KRYSTALLFORMEN, *Heidelberg*, 1913, **2**, pl. 77, fig. 1395.

[11] Vrba, *ibid.*, pl. 79, fig. 1424.

[12] Rath, *ibid.*, pl. 86, figs. 1510-1511.

[13] Duffour, *Bull. Soc. Fran. de Min.*, **46**, 95-101, 1923.

[14] Penfield and Ford. *Amer. J. Sci.* [4], **9**, 352-354, 1900.

A PECULIAR MANGANIFEROUS SERPENTINE FROM FRANKLIN FURNACE[1]

EARL V. SHANNON, *U. S. National Museum*
and
ESPER S. LARSEN, *Harvard University*

Some two years ago a specimen of a peculiar red-brown mineral was sent to Professor Larsen for identification by Col. Roebling. Although this material superficially resembled garnet its optical properties were such that it could not be that mineral and, at the request of Professor Larsen, Mr. Shannon agreed to analyze the mineral and Colonel Roebling gave his permission for the removal of enough material from the specimen for the analysis. The specimen, following the preliminary microscopic examination, was returned to Col. Roebling who, somewhat later sent it again to

[1] Published by permission of the Secretary of the Smithsonian Institution.

Mr. Shannon at the National Museum for chemical investigation. The small specimen was regrettably mislaid and has only recently been brought to light. The red-brown garnet-like appearing constituent has been separated by the use of heavy solutions and upon analysis has proven to be a manganiferous variety of serpentine of sufficient uniquity of composition, appearance, and optical properties to warrant the following brief description.

The specimen is a small flat piece which bears the following label, in Colonel Roebling's handwriting: "Unknown mineral from Franklin, 1890. Has been called massive garnet but is not that: W.A.R." In color the mineral is red-brown with a somewhat resinous luster and greatly resembles massive garnet. The fracture is imperfectly conchoidal and the material is rather hard, the hardness apparently being near that of apatite or 5.5. The material covers an area 3 by 4 centimeters to a depth of 5 millimeters and is found on a granular aggregate of franklinite, willemite, calcite and bronzy biotite. Although the color of the mineral in the specimen is distinctly red, the powder is golden brown with no red tint and, after ignition, this is changed to pale grayish brown. The crushed powder was purified by the use of methylene iodide-bromoform solutions and was found to vary somewhat in specific gravity. The lightest sample, which was proven pure by microscopic study, was used for the analysis and gave the following results:

Analysis of the Manganiferous Serpentine

SiO_2	41.32
Al_2O_3	0.65
FeO	1.57
MnO	7.57
ZnO	0.14
MgO	32.58
CaO	0.96
H_2O+	12.44
H_2O-	0.94
Total	98.17

The low summation doubtless indicates the presence of minor amounts of alkalies and possibly some other constituents not determined owing to scarcity of material. The composition is clearly that of a serpentine although the presence of nearly eight per cent of manganese oxide as an integral constituent is unique.

Optically the material presents the characters of a metacolloid but gives fair data. It is optically negative with $2V$ medium. The refractive indices are $\alpha=1.561$, $\beta=1.567$, $\gamma=1.568$. These data bring the mineral very close to bowlingite and antigorite in Larsen's tables which should have identified it as a serpentine had it not been for its unusual appearance and manganese reaction.

The writers' thanks are due Colonel Roebling for the privilege of investigating the material.

GEODE CONCRETIONS FROM THE BLACK HILLS, SOUTH DAKOTA

G. M. Schwartz, *University of Minnesota*

Introduction

In 1921, while on field work in the Black Hills with a class, the writer found a number of rather unique geode concretions, in some cases lined with amethystine quartz and various other minerals. In the spring of 1924, the spot was revisited during the annual field trip of the Department of Geology of the University of Minnesota. The occurrence seemed so unusual that the exposure was examined in detail and the concretions studied in the laboratory with the results noted. With the aid of the students several hundred concretions were obtained from the shale and the slopes below. These were broken and the best examples of each type retained for study.

Geologic Occurrence

The Black Hills represent the farthest east outliers of the Rocky Mountain system. They were formed by a domical uplift at the end of the Cretaceous which exposed all of the earlier formations from the granites and schists of the pre-Cambrian to the thick series of Cretaceous sediments. The concretions were found in the shale, which forms the lower part of the Englewood formation (Mississippian), on a bluff of the canyon of Whitewood Creek in the northwest quarter of Section 7, T. 5 N., R. 4 E. This is about three miles below Deadwood and nearly a mile east of the point where the creek bends away from the tracks of the Chicago and Northwestern railroad.

The following section was measured on the cliff:

Mississippian	Pahasapa limestone 80 feet. Massive white limestone. Englewood formation 64 feet, 32 feet of concretion shale with buff limestone above.

Ordovician—Whitewood formation 85 feet; very massive buff dolomite.

The concretions were limited to the shale of the Englewood formation and a detailed section showing their distribution is as follows:

13 feet,	chocolate colored to reddish shale. Many concretions and the shale itself has a concretionary structure at places.
6 feet,	gray, sandy, thin-bedded shale with many concretions.
10 feet,	very thin-bedded chocolate colored paper shale. Few concretions.
3 feet,	yellow sandy shale. No concretions.

Aside from the exposure described above, the concretions were noted at one other place which was on the north side of Whitewood Creek in the same vicinity. They are evidently local, as neither Darton,[1] Irving,[2] nor Darton and Paige[3] mention them, and they are not present at other exposures of the shale seen by the writer.

The concretions are irregularly distributed in the shale both horizontally and vertically. At places they occur more or less in groups or nests but for the most part are found singly. It seems from the manner in which they are embedded in the shale that they originated after the deposition of the mud, but before induration, as there is no evidence of a cracking or breaking of the shale layers.

Description of the Concretions

The concretions vary from half an inch to fully 6 inches in diameter, but most of them are from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. (See Fig. 1.) Practically all of them have a similar shape, that of a somewhat flattened sphere with an irregular knobby surface. They are gray in color and the outside is apparently chalcedony with a concretionary or concentric structure. Many, especially the larger ones, are hollow and the vugs are lined with colorless or amethystine quartz, or calcite crystals with lesser amounts of other minerals noted below. A small percentage of them are solid and the interior is filled with quartz, calcite, ankerite, siderite, limonite and hematite. Rarely entire concretions are composed of marcasite and its oxidization products.

---

[1] Darton, N. H., Geology and water resources of the northern portion of the Black Hills: *U. S. Geol. Survey Prof. Paper* **65,** (1909).

[2] Irving, J. D., Economic resources of the northern Black Hills: *U. S. Geological Survey Prof. Paper* **26,** (1904).

[3] Darton, N. H., and Paige, Sidney, *U. S. Geol. Survey Folio* **219,** (1925).

A study of thin sections of several typical concretions confirmed the identification of the several minerals made in hand specimens and brought out several other facts. The major part of most of the concretions is silica in the form of coarse crystals of quartz. There was originally a large amount of chalcedony, but much of this has recrystallized to quartz. Some still retain the radiating and spherulitic forms characteristic of chalcedonic material. One of the most conspicuous features is the multitude of inclusions which occur in an interior zone of many of the quartz crystals, whereas the exteriors of the crystals are perfectly clear. Most of the inclusions seem to be sericite. This is a feature of practically all of the slides examined. Many specimens contain greater or less amounts of pyrite mixed with the quartz, calcite, ankerite, or siderite which lines the vugs or completely fills the interior. In practically all cases the exterior of the concretions is chalcedony grading to coarser quartz on the interior.

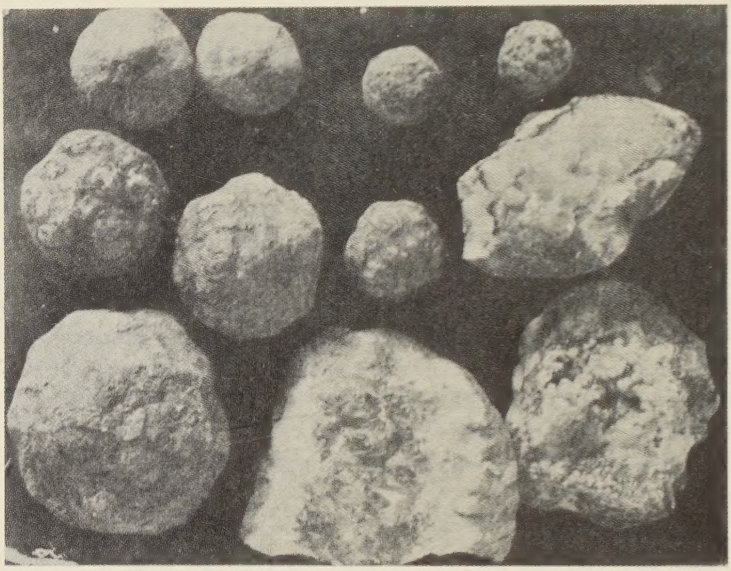

Fig. 1. Photograph of several concretions showing form and variation in size. The three on the lower right hand side have been broken and show the coarse crystals more or less completely filling the interior. *One-half natural size.*

In general the concretions are unusual for the variety of minerals composing them and for their structure. They are certainly concretionary forms as is clearly indicated by their structure and mode of occurrence in a limited area and horizon of the shale. An explanation of the mode of origin does not readily appear.

It has been suggested that the original concretions were formed before induration of the shale. The geode structure and numerous minerals indicate a change from the original material as concretions normally consist of but one or two minerals, and grow from the center outward. Perhaps the original concretions consisted of some soluble mineral which was dissolved and various minerals substituted, notably quartz. This would account for the partly filled centers of many of the concretions. The solutions which accomplished this result may very well have been of hydrothermal nature, as the surrounding country is invaded by numerous porphyry sills, dikes, and laccoliths. The presence of much sericite in the quartz would be a further indication of hydrothermal action.

THE IDENTITY OF NEWTONITE WITH ALUNITE

William F. Foshag,[1] *United States National Museum*

In 1891 Brackett and Williams[2] described two new clay minerals from Arkansas. One occurring as soft white masses at Sneeds Creek in Newton County was named *newtonite* after the locality. This locality has recently been revisited and described by E. T. Wherry.[3]

Newtonite, as described by Brackett and Williams, is found in nodular masses of a pure white color embedded in a soft clay. Microscopic examination showed it to be a remarkably pure substance. The characteristic feature of this mineral is its occurrence in minute rhomb-shaped crystals clearly distinguishable under the higher powers of the microscope. An analysis of this mineral yielded the following:

[1] Published with the permission of the Secretary of the Smithsonian Institution.

[2] Am. J. Sci., **42,** 11, 1891.

[3] Am. Mineral., **10,** 350-351, 1925.

ANALYSIS OF NEWTONITE. (BRACKETT AND WILLIAMS.)

SiO_2	40.22
Al_2O_3	35.27
Fe_2O_3	0.21
CaO	0.54
MgO	trace
Na_2O	0.99
K_2O	0.73
Ignition loss	22.89
	100.85

The above quoted analysis is similar in every way to that of normal halloysite, Al_2O_3. $2SiO_2$. aq. According to the original description newtonite is only slightly attacked by hydrochloric acid but is completely soluble in sulphuric acid with the separation of silica. It is also decomposed by boiling caustic potash solution.

Material exactly similar in every way to that described by Brackett and Williams was collected by Wherry and turned over to the United States National Museum, in which the supposed species had been hitherto unrepresented, with the recommendation that it be reinvestigated, as it seemed to occupy an anomalous position in the aluminum silicate series, and some error might have been made in connection with the original analysis. Accordingly, the writer undertook the examination of this mineral. Before the analysis was begun Professor E. S. Larsen suggested the possibility of newtonite being identical with alunite and this has actually proven to be the case. For analysis a soft nodule was selected and screened to separate the coarse quartz that was present in small amounts. The material used for analysis was made up of minute rhomb-shaped crystals with less than 1% of quartz. The analysis follows:

ANALYSIS OF ALUNITE (NEWTONITE)

SO_3	34.92
SiO_2	0.96
Al_2O_3	38.56
CaO	0.78
MgO	0.30
K_2O	8.23
Na_2O	0.80
H_2O	15.15
	99.70

From the above analysis it is quite evident that the material represented by the minute rhomb-shaped crystals is in fact, normal alunite. The optical properties of these crystals because of their small size are rather difficult to measure. Their mean index of refraction is 1.58. Larsen[4] gives for newtonite the following optical properties.

$\omega = 1.560$, $\epsilon = 1.580$. Optically positive.

These values are essentially the same as those for alunite:

$\omega = 1.572$, $\epsilon = 1.592$. The chemical reactions given for newtonite are also similar to those of alunite. Both are insoluble in hydrochloric acid but soluble in sulphuric acid and in boiling caustic potash solution.

There can be but little doubt that the crystalline material made up of minute rhomb-shaped crystals and described as newtonite is really alunite. The analysis of the material given by Brackett and Williams cannot be interpreted as a mixture of alunite and quartz, as some of the specimens actually are, but the analysis and the optical investigations must have been made on two entirely different materials. From the analysis given in the original description the material investigated chemically must almost certainly have been halloysite. "Newtonite" is therefore to be stricken from the list of mineral species.

---

[4] *U. S. Geological Survey Bulletin*, No. **679**, p. 115.

SOME MINERALS FROM THE KENSINGTON MICA MINE, MONTGOMERY COUNTY, MARYLAND[1]

Earl V. Shannon

An old mica mine, worked from 1882 to 1884 and known then as the Gilmore mine is located in Montgomery County, Maryland, on Northwest Branch about 2 miles north of Burnt Mills. This mine has been described briefly by Sterrett.[2] The only noteworthy fact regarding the mineralogy of the locality heretofore recorded was the occurrence of gahnite. While the mine was being worked it was visited by Doctors Geo. P. Merrill and Frank Wigglesworth Clarke. On this visit Dr. Merrill collected a large mass of gahnite.

---

[1] Published by permission of the Secretary of the Smithsonian Institution. The seventh preliminary paper on the minerals of Maryland prepared in cooperation with the Maryland Geological Survey.

[2] Douglas B. Sterrett. Mica Deposits of the U. S. *U. S. Geol. Survey Bulletin* **740**, pp. 104-105.

This was analyzed by Chatard and is described as a dark green massive specimen filling a cavity in feldspar. Other minerals mentioned from the locality are mica, quartz, albite, garnet, black tourmaline and beryl.[3] The gahnite specimen is not now in the Museum and was probably lost in the laboratory at the time it was analyzed. The following notes on this locality are from the writer's visits in connection with the study of the minerals of Maryland, accompanied by Doctors Wm. F. Foshag, Edward Sampson, and Waldemar T. Schaller.

The mine openings are now entirely obliterated and overgrown with woods but they are extensive and easily recognized as soil-filled depressions. The dumps, however, are large and contain much fresh material from the pegmatite. It is in these that collecting must be done since no rock can be seen in place. As is to be expected, quartz, mica and feldspar make up most of the blocks. Most of the larger crystals of mica were taken away and those which remain show twinned structure. The feldspar is in part flesh red microcline perthite, more or less replaced by white albite. Much of the feldspar, although pinkish in color, forms loose textured cellular masses of blades and is obviously the cleavelandite variety of albite. Optically it is biaxial positive with 2V large, $\beta = 1.530$.

Tourmaline was not seen in the pegmatite proper but imperfect black crystals are abundant in muscovite schist from the walls. These are intensely pleochroic under the microscope in powder with $\omega =$ blackish green, almost opaque, and $\epsilon =$ pale greenish brown. The refractive indices are $\omega = 1.670$, $\epsilon = 1.640$; $\omega - \epsilon = .030$. A single large crystal of beryl was found. This was imperfectly formed and weighed in the neighborhood of 20 pounds. When broken it was found to be dense and tough and to have a peculiar greenish-yellow color and somewhat resinous luster. It included considerable apatite and a little muscovite.

Apatite occurs as blue-green masses up to 2 inches in diameter included in beryl or in the cleavelandite. Under the microscope it is uniaxial, negative, and marked by numerous elongated cavities parallel to the vertical axis. The indices are $\epsilon = 1.633$, $\omega = 1.636$.

Small rusty cavities surrounded by radiating cracks and rust stain and occasionally autunite suggest the former presence of a rare earth mineral. Small grains forming the nucleus of such rosettes of cracks are resinous brown with conchoidal fracture. These are high in uranium as shown by the autunite formed by their alteration and resemble hatchettolite more than any other mineral of this group.

---

[3] *U. S. Geol. Survey Bull.*, **9**, p. 9, 1884.

Autunite occurs principally as a thin yellow stain which occasionally in the thicker portions shows tabular structure and a greenish fluorescence. Under the microscope it is biaxial, negative, with 2V small, α=about 1.555, β=1.575, γ=1.578. It is pleochroic with X, colorless; Y and Z, pale yellow.

Ocherous manganese oxide occurs as spots up to an inch or more in diameter, sometimes surrounded by a rim of granular yellowish mica. Some of these certainly represent altered garnet but others look like the remains of manganese phosphates.

Garnet occurs in ill defined brownish-red masses up to an inch or more in diameter. Occasional imperfect faces of the dodecahedron are to be seen but most of the masses are interstitial with relation to platy feldspar and show no crystal faces. The garnet is in part altered to manganese oxide. A carefully prepared and purified sample, washed free from black oxide by dilute hydrochloric acid was homogeneous with a refractive index of 1.813±.002. This was analyzed and found to be relatively pure spessartite. The analysis gave the following results and ratios:

ANALYSIS OF SPESSARTITE

	PER CENT		RATIOS	
SiO_2	35.76	.596	.199×3	.98×3
Al_2O_3	20.72	.203	.208×1	1.03×1
Fe_2O_3	0.76	.005		
CaO	1.22	.021	.204×3	1.01×3
MgO	0.50	.013		
MnO	34.40	.484		
FeO	6.66	.093		
	100.02			

This close agreement with the garnet ratios is of interest since another spessartite recently analyzed by the writer, as well as the one previously described from Amelia, Virginia, does not agree with the ordinary formula for garnet unless a considerable amount of the manganese is assumed to be in the trivalent state.

The presence of cleavelandite, spessartite, apatite, beryl and rare earth minerals indicates that this is a pegmatite mass of unusual interest quite different mineralogically from the ordinary granite pegmatites of this region.

RADIATED CHRYSOTILE FROM FRANKLIN FURNACE, NEW JERSEY[1]

WILLIAM F. FOSHAG, *U. S. National Museum*

During a recent trip to Franklin Furnace a number of specimens were noted in the collections that were generally called "wavellite" because of their characteristic radiated structure. One of these (U. S. N. M. 95208) was obtained and found on examination to be serpentine, variety chrysotile.

The chrysotile forms radiated groups made up of silky fibers. The individual fibers are as much as 3/4 centimeters long, and are easily separable into silky threads. The color is light hair brown, the luster silky. These radiated groups are embedded in a white to pink and brown calcite. Associated with them is a massive brown serpentine and a few small grains of franklinite.

The optical properties of the radiated mineral are as follows: Biaxial, negative. 2V is medium small.

$$\alpha=1.546, \quad \beta=1.550, \quad \gamma=1.557, \quad \text{all} \quad \pm.003.$$

The plane of the optic axes is parallel to the fibers, Z = length of fibers. Elongation (+). Parallel extinction. These data are near those given in Larsen's Tables for chrysotile but are slightly higher. There seems to be a tendency for the grains to lie parallel to the plane of the optic axes, suggesting that the cleavage in this direction is somewhat better than the other cleavages.

Material for analysis was obtained by selecting apparently clean, radiating fibers. Microscopic examination, however, showed that the fibers included some calcite grains. A large part of the calcite was eliminated by screening and the remaining small percentage dissolved out with citric acid. The sample thus prepared was washed and air dried and found to be essentially free from extraneous materials. The following composition was determined on this sample by standard chemical methods:

H_2O-	2.31
H_2O+	14.51
SiO_2	41.47
Al_2O_3	0.10
FeO	0.90
CaO	0.83
MgO	38.40
MnO	0.71
Alkalies	0.42
	99.65

---

[1] Published with the permission of the Secretary of the Smithsonian Institution.

This analysis shows the mineral to be normal chrysotile. The somewhat high water content is probably due to adsorption through washing.

There has been much discussion regarding the origin of chrysotile and two general hypotheses have been proposed not only to account for the formation of the mineral but of its characteristic fibrous structure as well. The first hypothesis is that the chrysotile grew by pushing apart the inclosing walls and that the fibrous nature is due to the introduction of the chrysotile bearing solutions through numerous closely spaced pores. The second theory is that the chrysotile is a result of the replacement of the wall rock. Without entering into a discussion of the relative merits of these two ideas it may be pointed out that the Franklin Furnace mineral, because of its radiated structure, can most reasonably be considered as a replacement of the inclosing calcite; and that the fibrous structure is not due to any vagaries of deposition from solution, but is a property inherent in the mineral itself. The *normal* cleavage habit of chrysotile is fibrous.

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

Regular Monthly Meeting of May 13, 1925

At a regular monthly meeting of the New York Mineralogical Club held in the Morgan Memorial Hall of the American Museum of Natural History, on the evening of May 13, the Gratacap Memorial Tablet was formally presented to the Museum by the Club and unveiled.

Dr. George F. Kunz, President of the Club, made the presentation address. President Henry Fairfield Osborn accepted the tablet on behalf of the Trustees of the Museum. The Rev. Henry Mottet, a classmate of Doctor Gratacap, spoke eloquently of his personality and magnetism. Mr. Lewis Sayre Burchard, praised his gifts as a writer and a public speaker. Mr. George C. Lay, outlined the Gratacap ancestry and told of his theological studies. Mr. Joseph L. Buttenwieser, President of the Alumni Association of the City College, spoke of his interest in his Alma Mater and her graduates.

Mr. Gilman S. Stanton, speaking in behalf of the Mineralogical Club, related instances of his interest in and inspiration extended to boy students and collectors. Mr. Herbert P. Whitlock, who succeeded him as Curator of Mineralogy in the American Museum, spoke with great appreciation of the work of Louis Pope Gratacap as a curator.

The members of the Club present and the friends and former associates of Dr. Gratacap then viewed the memorial tablet which has been placed upon the north wall of the Morgan Memorial Hall, and is carved in light buff marble, harmonizing with the general color of the Hall. It bears a portrait of Dr. Gratacap, by Albert T. Stewart over the following inscription:

In memory of Louis Pope Gratacap,
Scientist, Author, Educator, for
forty-one years in charge of the
Minerals of this Museum, and for
sixteen years Curator. Erected by
the New York Mineralogical Club.

In an upright case, in close proximity to the tablet, was displayed a selection from the published and manuscript works of Dr. Gratacap, assembled by the Mineralogy Department of the Museum.

HERBERT P. WHITLOCK, *Recording Secretary*

Regular Monthly Meeting of October 21, 1925

A regular monthly meeting of the New York Mineralogical Club was held in the East Assembly Room of the American Museum of Natural History on the evening of October 21, 1925. The President, Dr. George F. Kunz, presided and there was an attendance of thirty-one members.

The following names were submitted for membership to the committee on membership:

Mr. Edward A. Zimmerman,	128 Convent Ave., N. Y. City
Dr. G. Winslow Plummer,	321 West 101 St., N. Y. City
Mr. Arthur J. Erregir,	595 Prospect Ave., Bronx, N. Y. City
Mr. Donald Selchow,	Yale University, New Haven, Conn.
Mr. Edward E. Schmidt,	267 Bloomfield Ave., Verona, N. J.

The secretary called to the attention of the Club the death, during the summer, of Mr. Joseph P. Wintringham, and read a resolution which was passed and a copy ordered transmitted to Mrs. Wintringham. The resolution follows:

> The members of the New York Mineralogical Club, at a meeting held on October 21, unanimously joined in expressing their grief at the recent loss of their fellow member, Mr. Joseph P. Wintringham, and extend their sincere sympathy to you in your great sorrow. The following minute has been placed upon the records of the Club:
>
> By the recent death of Mr. Joseph P. Wintringham, for many years associated with us as an enthusiastic and valued member of this Club, our organization has suffered a severe loss and we, individually and collectively feel a keen personal sorrow.
>
> Mr. Wintringham combined in his personality a clear and logical mind with a sympathetic and modest demeanor. His opinions were always timely and constructive. The loss of a man of such sterling qualities always means much to the world at large; to us who knew and appreciated his rare gifts it means far more.

Mr. Grenzig called attention to the recent death of Mr. William G. Rothe and spoke of his association with the Club as a former enthusiastic member. The President named the following committee to draw up a suitable resolution on the death of Mr. Rothe: Messrs. Stanton, Grenzig and Ashby.

Mr. Broadwell exhibited a series of minerals including stilbite from Pennington, N. J., barite from the Hopewell Barite mine, a number of minerals associated with the serpentine from Green Swamps Dam, and epidote and crocidolite from Ringwood, New Jersey.

Mr. Manchester displayed some fine quality rose quartz from the new Kinkle Quarry at Bedford, New York, and an interesting series from Snake Hill and Paterson, New Jersey. Mr. Grenzig showed some West Paterson minerals including prehnite incrusting calcite and barite, thomsonite, analcite and calcite; also calcite from Snake Hill, New Jersey.

Dr. Allen spoke of a trip to the recently discovered ledge of fossils in Saratoga County, New York. Mr. Walther exhibited pink, yellow and white botryoidal prehnite and crystallized barite from West Paterson, calcite showing gliding planes from the Parker Mine, Franklin, and altered spinel. Mr. Hoadley described an interesting trip with Mr. Scheerer to the Haddam localities where chrysoberyl and pink muscovite were obtained, also a visit to the nearby iolite locality. He also announced his rediscovery of the corundum locality at Black Horse, Pennsylvania, from which locality he obtained specimens. Among Mr. Hoadley's collection from Franklin was a type specimen of schallerite, margarosanite, rhodonite and garnet. He announced the fact that the Tilly Foster locality was closed to collectors. He spoke of the Waterbury aqueduct locality for zeolites.

Mr. William L. Clark exhibited muscovite with long included crystals of tourmaline obtained from the excavation for the New Medical Center at Fort Washington Avenue and 168th Street. He presented this specimen to the Club's Collection.

The Election Day Field Trip was discussed and a committee consisting of Messrs. Hoadley, Radu and Broadwell was appointed to arrange if possible a trip to the West Paterson Quarries. The meeting then adjourned.

HERBERT P. WHITLOCK, *Recording Secretary*

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences of Philadelphia, Nov. 12, 1925

A stated meeting of the Philadelphia Mineralogical Society was held on the above date, with an attendance of twenty-nine members and ten visitors. President Vaux was in the chair.

Mr. Horace Fletcher, Jr., was elected to membership, and Mr. Ferdinand K. Ettinger to junior membership.

Dr. W. T. Schaller, of the U. S. Geological Survey, Washington, D. C., addressed the society on "*How Pegmatites Form,*" and presented his view, recently published in the *American Journal of Science*, of the origin of the pegmatite minerals by replacement from aqueous solutions. From his studies of the California pegmatites he has concluded that most of the minerals to which they now owe their importance were not formed by direct crystallization from a molten magma, but that after solidification the original dike was greatly altered by invading solutions, which acted slowly over a long period of time. These solutions dissolved some minerals and deposited others, so that comparatively few of the large number of minerals now observed in the dikes can be considered as having been present originally.

The speaker showed, with the aid of a series of excellent lantern slides and several large specimens, that the California pegmatites were composed entirely of graphic granite at some stage in their history, and that the characteristic arrangement of the quartz crystals in the graphic granite can still be plainly traced through those parts of the dikes which now consist chiefly of albite and garnets. The microcline of the graphic granite was probably first replaced by albite, and the albite later by tourmaline, garnet, muscovite, lepidolite, and other minerals. Residual microcline crystals, often much corroded, are found all through the dikes. The extent of the replacement varies considerably for different dikes.

The theory raises many interesting questions as to the origin of minerals. Perhaps all albite and all hydrous minerals are always formed by replacement processes. Dr. Schaller's talk was followed by a very interesting discussion of the subject, in which several members of the society participated.

Mr. Samuel G. Gordon then presented in abstract a paper entitled *Penroseite and Trudellite, two new minerals.* Their characters are:

> PENROSEITE, $5(Ni,Co)Se_2.2PbSe_2.3CuSe$; orthorhombic. Color lead-gray; streak black; luster metallic; opaque; hardness 3; brittle; specific gravity 6.93. Form: radiating masses, with four cleaveges: *c* (001), perfect but curved; *a* (100), and *b* (010), perfect, and *m* (110) distinct. Mineralography: cream colored; HNO_3 effervesces, rapidly etching to a rough gray surface, fumes tarnish brown; HCl negative; KCN tarnishes brownish, rubs paler; $FeCl_3$ and $HgCl_2$ negative. An analysis by Dr. J. E. Whitfield gave: Se 59.80, Ag 2.04, Pb 17.13, Cu 7.84, Ni 11.14, Co 1.34, Fe_2O_3 $1.08=100.37$. Locality: Colquechaca, Bolivia.
>
> TRUDELLITE, $Al_2(SO_4)_3.4AlCl_3.4Al(OH)_3.30H_2O$; trigonal. Color amber-yellow (Ridgway); luster vitreous; translucent; hardness, 2.5; specific gravity 1.93. Form: massive, with an indistinct rhombohedral cleavage. Optically uniaxial, negative: $\epsilon=1.495$, $\omega=1.560$; $\omega-\epsilon=0.065$. The mineral is extremely deliquescent. An analysis by Mr. Earl V. Shannon gave: SiO_2 0.57, Al_2O_3 25.67, Fe_2O_3 1.00, CaO 1.56, MgO 0.66, Na_2O 1.58, SO_3 13.60, Cl 24.42, H_2O $36.60,=105.66$; less $O=2Cl$ 5.49, $=100.17$. Locality: Cerro Pintados, Tarapaca, Chile.

The latter mineral was named after Mr. Harry W. Trudell, formerly business manager of THE AMERICAN MINERALOGIST, who was present and who received the announcement with considerable surprise. He was presented with a specimen.

Mr. Cienkowski reported trips to several Pennsylvania and New Jersey localities. After a vote of thanks to Dr. Schaller the meeting adjourned.

HORACE R. BLANK, *Secretary*

Academy of Natural Sciences of Philadelphia, December 10, 1925

A stated meeting of the Philadelphia Mineralogical Society, attended by thirty-six members and seven visitors, was held on the above date, with the president, Mr. Vaux, in the chair. Mr. Robert Goetz, of Philadelphia, was elected a junior member.

The speaker of the evening was Mr. Samuel G. Gordon, of the Academy of Natural Sciences of Philadelphia, who described his recent experiences on *The Third Academy Mineralogical Expedition, Bolivia, 1925.* After a steamship trip from New York to the west coast of South America, he entered Bolivia by rail from Arica, Chile. The most important mine visited was that at Llallagua, Bolivia, where a three weeks visit yielded many fine specimens of cassiterite, wavellite, vivianite, vauxite, and paravauxite. The thrills of collecting in this mine, with its fifty miles of tunnels and almost total absence of safety devices, were dwelt upon at length. At the silver mines of Colquechaca, reached by mule from Llallagua, the new mineral penroseite was found. At various other mines in Bolivia excellent specimens of tealite, cylindrite, wolframite, and other minerals were secured. The speaker travelled by railroad, auto, mule, and even by aerial tramway between the various localities.

Continuing southward into Chile, the speaker collected minerals in the nitrate districts on the Atacama desert, in spite of an incipient revolution which was brewing at the time. Trudellite, a new mineral, and tamarugite were the most interesting finds in this region, and Cerro Pintados and Copiapo the best localities. The return voyage was made from Valparaiso.

The talk was illustrated throughout by many lantern slides, the splendid views of the mountain scenery in the Andes being particularly appreciated by the audience.

HORACE R. BLANK, *Secretary*

NEWARK MINERALOGICAL SOCIETY

The seventy-sixth regular meeting of the Newark Mineralogical Society was held on November 1, with President Miller presiding. Twenty-three members were present.

The annual session was opened by the re-election of all the present officers; President: Thos. I. Miller; Vice-President: Geo. F. Black; Secretary: Wm. H. Broadwell; Treasurer: H. M. Lehman. The treasurer reported a balance of cash on hand of $20.65. The secretary reported an increase in membership during the year of fourteen making a total of fifty-nine as the present membership. Three applications were acted upon and three more were received and turned over to the membership committee.

Mr. O. Ivan Lee then gave an interesting lecture on his recent trip through North Carolina where he visited many well known localities. He exhibited a large number of specimens collected on this trip. At its conclusion a vote of thanks was tended him and adjournment followed.

WM. H. BROADWELL, *Secretary*

The seventy-seventh meeting of the Newark Mineralogical Society was opened in the auditorium at 3:30 P.M., December 6, by President Miller who introduced the speaker of the day, Dr. M. W. Twitchell, Assistant State Geologist, who gave an illustrated lecture on *The Geological Story of New Jersey*. Upon its conclusion the members adjourned to the Hotel St. Francis for a dinner in honor of the Society's tenth anniversary.

Of the thirteen charter members, eight are still members, one has been made an honorary member; two have died; three have resigned. Of the eight original members six are still active in the affairs of the Club. Of the original officers, Wm. H. Broadwell has held the office of secretary and H. M. Lehman the office of treasurer continuously for the period of ten years. Starting with thirteen members the Club has grown to the present membership of fifty-nine. The Society was organized in 1915 and incorporated in 1925.

WM. H. BROADWELL, *Secretary*

NEW MINERALS: DOUBTFUL SPECIES

CLASS: PHOSPHATES, ETC.

Lehnerite

F. Müllbauer: Die Phosphatpegmatite von Hagendorf i. Bayern. (The phosphate pegmatites of Hagendorf, Bavaria.) *Zeit. Kryst.*, **61**, 331, (1925).

Name: Named after the mineral collector *Lehner*.

Chemical Properties: A hydrous basic phosphate of iron. Formula: $7FeO. 2P_2O_5. 6H_2O$. Analysis: P_2O_5 34.20, FeO 46.35 ,MnO 2.95, MgO 2.43, H_2O 14.07. Sum 100. (Analysis after deduction of insoluble material and alumina.)

Crystallographical Properties: Monoclinic, prismatic, with forms (001), (110), (101), (109), $(\bar{1}05)$, (122), $(\bar{4}32)$. $a:b:c = 0.8965:1:2.4939$. $\beta = 110° 23'$.

Physical and Optical Properties: Color apple green. Biaxial, positive. Plane of the optic axes is parallel to (010). Bx_a makes about 28° with the normal to *c*. Cleavage parallel to the base, perfect.

Occurrence: In small crystals or grains and veins between triploidite crystals, in apatite, or in cracks in triplite or triphylite at Hagendorf, Bavaria.

Discussion: This mineral is very near to ludlamite in composition. The optical and crystallographic data, however, are not sufficiently detailed to determine with certainty the relation of this mineral to ludlamite. W.F.F.

Wentzelite

Op. Cit., p. 333.

Name: Named in honor of Father Hieronymus *Wentzel*, discoverer of the Ploystein phosphate locality.

Chemical Composition: A hydrous phosphate of manganese. Formula: $3MnO. P_2O_5. 5H_2O$. Analysis: P_2O_5 39.37, FeO, 6.01, MnO 21.13, MgO 6.83, H_2O 23.66.

Crystallographical Properties: Monoclinic, prismatic. Forms (100), (001), (110), $(\bar{1}01)$, $(\bar{1}13)$. $a:b:c = 2.3239:1:2.8513$.

Physical and Optical Properties: Color light rose to flesh red. Biaxial, optically negative, plane of the optic axes normal to the plane of symmetry. $Bx_a = b$.

Occurrence: Found as minute rosettes in cavities in kraurite.

Discussion: While this mineral is apparently a new normal phosphate of manganese further optical studies are necessary to establish it as a distinct species. W.F.F.

Baldaufite

Op. Cit., p. 334.

Name: Named after *Baldauf*, the collector of the single identified specimen.

Chemical Composition: A hydrous phosphate of iron. Formula: $3FeO. P_2O_5. 3H_2O$. Analysis: P_2O_5 38.94, FeO 27.16, MnO 9.39, CaO 6.73, MgO 2.74, H_2O 15.04.

Crystallographical Properties: Monoclinic, prismatic. Forms (100), (001), (110), $(\bar{1}01)$. Habit similar to wenzelite. $a:b:c = 2.21:1:1.84$. $\beta = 133° 18'$.

Physical and Optical Properties: Optically negative. Plane of the optic axes normal to the plane of symmetry. $Bx_a = b$.

Occurrence: Forms a small druse in a crack in quartz associated with kraurite.

Discussion: This mineral is identical in both habit and angles with wentzelite and hence probably isomorphous with that mineral. The mineral, however, needs detailed optical examination before it is acceptable as a new species. W.F.F.